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### **REMARKS**

Reconsideration is respectfully requested in view of the amendments and remarks herein.

#### **Status of Claims**

Claims 1, 20-24 and 46-95 are pending.

Claims 1, 20-24, 46-71 and 78-95 stand rejected.

Claims 72-77 stand objected.

Claims 2-19 and 25-45 are cancelled.

#### **Amendments After Final Action**

Applicants submit that the amendments made are appropriate after final Action since they place the application in condition for allowance of better condition for appeal.

Claim 64 is cancelled since it was the same as a claim in the parent patent.

Claims 66-68 are amended to recite that the reactor is a column reactor (vertical in claim 67), as supported at page 8, line 32 to page 9, line 14, etc. A number of the pending claims already recite that the invention is directed to a column reactor, so amending these claims should not require a new search or additional work.

Claims 72 and 74-77 were redrafted in independent form since the Action indicates that they will be allowed if so redrafted.

Claim 73 is cancelled in view of claim 34 of the parent patent.

Claim 83 is amended to add a hyphen to 1,3-propanediol.

Consequently, Applicants submit that the amendments do not change the issues under consideration and should be entered after final Action.

Entry and consideration are respectively requested.

#### **Claim 46 – 35 U.S.C. § 102(b)**

Claim 46 stands rejected under 35 U.S.C. § 102(b) as anticipated by Nishihira et al. US 5,731,453 (Nishihira).

Claim 46 is directed to a continuous multi-stage process comprising reacting at least one reactant in a liquid phase in an up-flow column reactor having two or

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more stages, and forming a gas or vapor phase by-product wherein the gas or vapor phase by-product is continuously removed at the top and at least one intermediate stage.

The Action states that Nishihira discloses preparation of a diaryl carbonate in multiple steps from A to D. Step A is carried out in two stages by forming an intermediate product, diaryl oxalate, while removing the by-product alkyl alcohol is in both stages (citing the entire disclosure, in particular column 4, lines 19-32). The by-product is stated to be gaseous (citing column 6, lines 26-38). The reaction is stated to be a liquid phase reaction (citing, for example, column 6, lines 34-38).

Applicants traverse this rejection for the reason that the invention is directed to an up-flow column reactor whereas Nishihira describes columns which are counter-current in nature. The reactions, reactors and their principle of operation are quite different.

Concerning this point, applicants point out that Nishihira repeatedly uses the term "reactive distillation." See for example Column 12, Lines 24-35 for reactor 'A' and Column 14, lines 21-25 for the two-stage process. Applicants submit that as used in Nishihira the term "distillation" means:

- (a) a molecular separation of components into vapor and liquid phases, and
- (b) a gravity-induced (or otherwise inertially-induced) macroscopic separation of vapor and liquid into streams flowing in opposite directions.

By the term "reactive distillation" is meant the conduct of a chemical reaction in a vessel in which distillation is also going on.

In the case of every one of the reaction vessels in Nishihira, there is liquid leaving the bottom and vapor leaving the top, which is consistent with distillation. In the claimed invention, there is molecular separation of components into vapor and liquid phases but there is no separation into oppositely-flowing streams. Vapor and liquid flow together to the top of the reactor, after which they are separated.

Advantages of this co-current up-flow reactor include:

- (a) ease of segmenting the reactor into successive stages between which there is negligible backflow, thus enhancing the volumetric effectiveness of the vessel as a reactor, and
- (b) in the case of polymerization, final separation of vapor and liquid only at a point where reaction has consumed substantially all volatile monomers.

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For the above reasons, applicants respectfully request withdrawal of the rejection of claim 46 under 35 U.S.C. § 102(b) as anticipated by Nishihira.

**Claims 1, 20-24, 47-63, 66-71 and 78-95 - 35 U.S.C. § 103(a)**

Claims 1, 20-24, 47-63, 66-71 and 78-95 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Morris et al., U.S. Patent No. 2,520,733 (hereinafter "Morris"), in view of Wagner et al, WO 98/27123 (hereinafter "Wagner"), corresponding to U.S. Patent No. 6,187,898 B1. Applicants' comments concerning Wagner are based upon the counterpart U.S. patent.

Claim 1 is directed to a continuous process of making polytrimethylene ether glycol comprising: (a) continuously providing 1,3-propanediol reactant and polycondensation catalyst; and (b) continuously polycondensing the 1,3-propanediol reactant to polytrimethylene ether glycol in a reactor having two or more reaction stages.

Claim 65 is directed to the process of claim 1 wherein the polycondensation is carried out in a reactor equipped with a heat source located within the reaction medium.

Claims 66-68 recite that the reactor is a column reactor having 3-30, 4-20 and 8-15 stages, respectively.

Claim 69 is directed to the process of claim 1 wherein the 1,3-propanediol reactant is fed at multiple locations to the reactor.

Claim 70 is directed to the process of claim 1 wherein an inert gas is added to the reactor at one or more stages.

Claim 71 is directed to the process of claim 1 wherein water vapor is generated as a by-product of the reaction and is removed from the reactor in at least one intermediate stage.

Claim 83 is directed to a continuous process of making polytrimethylene ether glycol comprising: continuously polycondensing a 1,3-propanediol reactant to polytrimethylene ether glycol in a reactor at a pressure of less than one atmosphere. Claims 84-89 depend directly or indirectly from claim 83. Claims 84 and 85 recite that polycondensation is carried out at pressures of less than 500 and 250 mm Hg, respectively. Claim 54 depends from claim 1 and recites that polycondensation is carried out at a pressure of less than one atmosphere. Claims 55-59 depend directly

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or indirectly from claim 83. Claims 55 and 56 recite that polycondensation is carried out at pressures of less than 500 and 250 mm Hg, respectively, and claims 57-59 depend therefrom. Claim 63 recites that the polycondensation pressure is between 50 and 250 mm Hg.

Morris is cited as teaching preparation of polymers and copolymers of 1,3-propanediol. The Action states that the invention is directed to a continuous process, whereas Morris is directed to a batch process. The Action also recognizes that the invention of claim 1 and the claims dependent thereon is directed to use of a reactor having two or more reaction stages. The Action cites Wagner as teaching a method for polycondensing a monomeric starting material with a reactor having at least two stages.

There seem to be no comments specifically directed to independent claim 83 in the Action. However, the Action points to Morris disclosing that water is removed under sub atmospheric pressure at column 6, lines 54-60, and that Wagner mentions a pressure of 0.01 to 100 bar at column 5, lines 31-45.

Applicants traverse this rejection for the reason that Morris is directed to a batch process and Wagner does not teach or suggest modifying the batch process of Morris to arrive at the claimed invention.

First, applicants submit that the reactions described in Wagner are quite different from those of the claimed invention or Morris and thus Wagner would not lead to modifying the process of Morris as suggested.

In addition, Applicants submit that the rejection of claim 1 and the claims dependent thereon should be withdrawn because those claims are directed to continuously *polycondensing* the 1,3-propanediol reactant to polytrimethylene ether glycol in a *reactor having two or more reaction stages*, whereas Morris is directed to a batch reaction and Wagner is directed to carrying out a reaction in two or more stages, not to continuously *polycondensing* a reactant to polytrimethylene ether glycol in a *reactor having two or more reaction stages*.

Further, Applicants submit that the rejection of Claims 54-59, 63 and 83-89 should be withdrawn since Morris is teaching using standard pressure and all of the examples in Wagner are directed to use of high pressures. Thus, the person of ordinary skill in the art would not be led to modify the process of Morris based upon the disclosure of Wagner.

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Specific comments directed to other claims are presented below.

Claims 1, 20-24, 47-63, 66-71 and 78-95

Applicants submit that Morris is focused on preparing polytrimethylene glycol using a batch process and that the reactions described in Wagner are quite different from those of the claimed invention or Morris, so that for this reason alone, the rejection should be withdrawn.

Morris is focused on preparing polytrimethylene glycol using a batch process. The polytrimethylene glycol is prepared by heating 1,3-propanediol and/or its derivatives using dehydration catalysts, such as sulfuric acid, phosphoric acid and sulfonic acids. (See, e.g., column 4, lines 31-40.) The preferred temperature range is 170-225°C. (Column 6, lines 11-13.) Polymerization is carried out by disposing all of the reactants in a vessel and heating with continuous or intermittent distillation of water. (Column 6, line 23 *et seq.*) Following polymerization, the product is usually purified by (a) removal of catalyst and dehydration. (Column 6, lines 39-66.) Morris' examples show preparing trimethylene glycol by a batch process using various catalysts and producing trimethylene glycol polymers having molecular weights of from 216 to 1,095. Thus, Morris does not teach or suggest a continuous process according to the invention.

Wagner is directed to a method for carrying out polycondensation reactions for preparing polymers that are very different than the polytrimethylene ether glycol of the invention. For instance, maleic acid is used to make polysuccinimide. Contrary to the statements in the Action, polyol is not a primary starting material. It is simply a "cocondensable" compound mentioned in US 6,187,898 B1, column 2, line 23 *et seq.* The preferred starting material is described in US 6,187,898 B1, column 2, lines 13-19 as the reaction product of 1,4-butanedicarboxylic acid or 1,4-butanedicarboxylic or a derivative thereof with ammonia or with a compound supplying ammonia. Other starting materials are described as maleic anhydride, fumaric acid, malic acid, aspartic acid, asparagines and mixtures thereof. (See, e.g., US 6,187,898 B1, column 2, lines 20-25.) Thus, the reactions described in Wagner are quite different from those of the claimed invention, and the person of ordinary skill in the art would not be led to modify of the process of Morris based upon the disclosure of Wagner.

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Claim 1 and The Claims Dependent Thereon

Applicants submit that the rejection of claim 1 and the claims dependent thereon should be withdrawn because those claims are directed to continuously *polycondensing* the 1,3-propanediol reactant to polytrimethylene ether glycol in a *reactor having two or more reaction stages*, whereas Morris is directed to a batch reaction and Wagner is directed to carrying out a reaction in two or more stages, not to continuously *polycondensing* a reactant to polytrimethylene ether glycol in a *reactor having two or more reaction stages*. Thus, combining Morris and Wagner would not lead to the process of these claims.

Morris is focused on preparing polytrimethylene glycol using a batch process. The polytrimethylene glycol is prepared by heating 1,3-propanediol and/or its derivatives using dehydration catalysts, such as sulfuric acid, phosphoric acid and sulfonic acids. (See, e.g., column 4, lines 31-40.) Polymerization is carried out by disposing all of the reactants in a vessel and heating with continuous or intermittent distillation of water. (Column 6, line 23 *et seq.*) Following polymerization, the product is usually purified by (a) removal of catalyst and dehydration. (Column 6, lines 39-66.) Morris' examples show preparing trimethylene glycol by a batch process using various catalysts and producing trimethylene glycol polymers having molecular weights of from 216 to 1,095. Thus, Morris does not teach or suggest a continuous process according to the invention.

In addition, applicants point out that step (b) of the invention is directed to continuously *polycondensing* the 1,3-propanediol reactant to polytrimethylene ether glycol in a *reactor having two or more reaction stages*. Wagner is directed to carrying out a reaction in two or more stages, not to continuously *polycondensing* a reactant to polytrimethylene ether glycol in a *reactor having two or more reaction stages*. Thus, even if Wagner is considered pertinent, it doesn't show the same type of reaction as claimed.

Concerning this point, applicants point to the fact that Wagner describes use of a pre-reactor and a high-viscosity reactor. Wagner describes the pre-reactor as being any apparatus suitable for heat exchange and having an operating capacity sufficient for carrying out the chemical reaction, such as a tube-bundle heat exchanger, a falling-film evaporator, a plate heat exchanger, a temperature controlled static-mixer reactor, a mixing vessel, etc. For the high-viscosity reactor,

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Wagner indicates a preference for using a helical-tube evaporator, or another heat exchanger in combination with a helical-tube reactor. These teachings would not lead the person of ordinary skill in the art to modify the batch process of Morris to arrive at the claimed invention.

Claim 65

Claim 65 is directed to the process of claim 1 wherein the polycondensation is carried out in a reactor equipped with a heat source located within the reaction medium. Column 2, lines 54-56, of Wagner specifically discloses the reaction carried out with external supply of heat in a reactor. Therefore, Applicants submit that Wagner does not teach the invention of this claim or how to modify the batch process of Morris to arrive at this invention.

Claims 66-68

Claims 66-68 recite that the reactor is a column reactor having 3-30, 4-20 and 8-15 stages, respectively. Applicants submit that these claims are patentable for the reasons given above with respect to claim 1. Moreover, given the specific teaching of Wagner, Wagner does not teach or suggest modifying the process of Morris to use this type of reactor.

Claims 69

Claim 69 is directed to the process of claim 1 wherein the 1,3-propanediol reactant is fed at multiple locations to the reactor. Applicants submit that Wagner does not teach the invention of this claim or how to modify the batch process of Morris to arrive at the claimed invention.

Claim 70

Claim 70 is directed to the process 1 wherein an inert gas is added to the reactor at one or more stages. Applicants submit that Wagner does not teach the invention of this claim or how to modify the batch process of Morris to arrive at this invention.

Claim 71

Claim 71 is directed to the process of claim 1 wherein water vapor is generated as a by-product of the reaction and is removed from the reactor in at least one intermediate stage. Applicants submit that Wagner does not teach the invention of this claim or how to modify the batch process of Morris to arrive at this invention.

Claims 54-59, 63 and 83-89

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Claim 83 is directed to a continuous process of making polytrimethylene ether glycol comprising: continuously polycondensing a 1,3-propanediol reactant to polytrimethylene ether glycol in a reactor at a pressure of less than one atmosphere. Claims 84-89 depend directly or indirectly from claim 83. Claims 84 and 85 recite that polycondensation is carried out at pressures of less than 500 and 250 mm Hg, respectively. Claim 54 depends from claim 1 and recites that polycondensation is carried out at a pressure of less than one atmosphere. Claims 55-59 depend directly or indirectly from claim 83. Claims 55 and 56 recite that polycondensation is carried out at pressures of less than 500 and 250 mm Hg, respectively, and claims 57-59 depend therefrom. Claim 63 recites that the polycondensation pressure is between 50 and 250 mm Hg.

There seem to be no comments specifically directed to Independent claim 83 in the Action. However, the Action points to Morris disclosing that water is removed under sub atmospheric pressure at column 6, lines 54-60, and that Wagner mentions a pressure of 0.01 to 100 bar at column 5, lines 31-45.

Applicants point out that Morris column 6, lines 54-60, is describing a purifying step carried out after polymerization. Column 6, lines 39-65, state that the purification first involves removal of catalyst and then dehydration. Distillation using subatmospheric pressure is given as one procedure for removing the last traces of water. Thus, Morris is not teaching carrying out polycondensing a 1,3-propanediol reactant to polytrimethylene ether glycol in a reactor at a pressure of less than one atmosphere.

Wagner, at column 5, lines 31-45, mentions use of pressure of from 0.01 to 100 bar in the pre-reactor and 0.01 to 10 bar in the high viscosity reactor. The Examples of Wagner, however, don't show pressures of low pressure. In fact, the only pressures mentioned are high pressures. Example 1, column 7, line 39, shows a pre-heater pressure of 10 bar and column 7, line 43, shows a tube evaporator being used at a pressure of 2.9 bar. In addition, Example 2, column 8, line 20, shows the pre-heater being operated at a pressure of 45 bar and column 8, line 24, shows a helical-tube evaporator being operated at 7.8 bar.

First, applicants submit that the teachings of Wagner are made with respect to a much different process than the process of the claimed invention, and therefore the person of ordinary skill in the art would not modify the teachings of Morris based



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thereon. Second, Wagner's examples don't show use of low pressure, and in fact show use of high pressures, so they would lead the person of ordinary skill in the art to away from the claimed invention. Therefore, there is nothing in Wagner that would lead the person of ordinary skill in the art to carry out polycondensing a 1,3-propanediol reactant to polytrimethylene ether glycol in a reactor at low pressure.

#### Summary

In summary, Applicants traverse this rejection for the reason that Morris is directed to a batch process and Wagner does not teach or suggest modifying the batch process of Morris to arrive at the claimed invention. First, applicants submit that the reactions described in Wagner are quite different from those of the claimed invention or Morris and thus Wagner would not lead to modifying the process of Morris as suggested. Second, Applicants submit that the rejection of claim 1 and the claims dependent thereon should be withdrawn because those claims are directed to continuously *polycondensing* the 1,3-propanediol reactant to polytrimethylene ether glycol in a *reactor having two or more reaction stages*, whereas Morris is directed to a batch reaction and Wagner is directed to carrying out a reaction in two or more stages, not to continuously *polycondensing* a reactant to polytrimethylene ether glycol in a *reactor having two or more reaction stages*. Further, Applicants submit that the rejection of Claims 54-59, 63 and 83-89 should be withdrawn since Morris is teaching using standard pressure and all of the examples in Wagner are directed to use of high pressures. Thus, the person of ordinary skill in the art would not be led to modify the process of Morris based upon the disclosure of Wagner. Lastly, Applicants submit that Wagner does not contain any disclosure concerning that would lead the person of ordinary skill in the art to modify the process of Morris to arrive at the inventions claimed in the other enumerated claims.

For the above reasons, applicants respectfully request withdrawal of the rejection of claims 1, 20-24, 47-63, 66-71 and 78-95 under 35 U.S.C. § 103(a) as over Morris in view of Wagner.

#### Claim 64-35 USC 101

Claim 64 was rejected under 35 USC 101. This claim was cancelled, so this rejection is moot.

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**Claims 72-77-Objection**

The Action indicates that claims 72-77 are allowable, but must be redrafted in independent form. Applicants have amended these claims so that they are in independent form.

**CONCLUSION**

In view of the present amendments and the above remarks, Applicants respectfully submit that all of the remaining claims are patentable and in condition for allowance. Accordingly, prompt favorable action is earnestly requested.

The Commissioner is hereby authorized to charge any fee deficiency or credit any additional charges to Deposit Account No. 04-1928 (E.I. du Pont de Nemours and Company).

Respectfully submitted,

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